



**Department of Natural Resources
Fisheries Enhancement**

A Fisheries Inventory of Night Owl, Horseshoe and Long Lakes, 1979

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ABSTRACT

This inventory was conducted from June 5 to June 19, 1979 to determine the sport fish potential of the lakes and provide baseline data to permit development of an allocation and use strategy for recreational fisheries. Night Owl, Horseshoe and Long lakes are mesotrophic lakes on the Precambrian Shield and as such are low in productive capacity. They have a small standing crop of fish and are probably at their climax capacity.

The limited angling potential offered by the walleye and northern pike populations of these lakes makes them unattractive as lodge lakes. Horseshoe Lake appears to offer limited trophy potential for walleye. An outcamp of ten beds could be considered for this lake.



TABLE OF CONTENTS

	Page
ABSTRACT	i
INTRODUCTION	1
METHODS	
Morphometry	8
Physical and Chemical Parameters	8
Plankton	9
Benthos	9
Fish	9
Calculations	11
RESULTS	
Morphometry	11
Physical and Chemical Parameters	13
Plankton and Benthos	18
Fish	18
Walleye Age and Growth	21
Northern Pike Age and Growth	21
Stomach Contents	30
Production Potential	30
DISCUSSION	
Morphometry	31
Physical and Chemical Parameters	32
Fish	33
MANAGEMENT IMPLICATIONS	37
RECOMMENDATIONS	40
ACKNOWLEDGEMENTS	41
LITERATURE CITED	42
APPENDIX	46

LIST OF FIGURES

Figure		Page
1	Geographic location of the study lakes	2
2	Bathymetric map of Night Owl Lake	5
3	Bathymetric map of Horseshoe Lake	6
4	Bathymetric map of Long Lake	7
5	Temperature - dissolved oxygen profiles of Night Owl, Horseshoe and Long lakes	14
6	Locations of chemical stations and fish collection sites in Night Owl Lake	15
7	Locations of chemical stations and fish collection sites in Horseshoe Lake	16
8	Locations of chemical stations and fish collection sites in Long Lake	17
9	Age-frequency distributions for walleye from Night Owl, Horseshoe and Long lakes	26
10	Age-frequency distributions for northern pike from Night Owl, Horseshoe and Long lakes	28
11	Angling yield related to the morphoedaphic index for a relatively homogenous group of Precambrian lakes in the Whiteshell Provincial Park	36

LIST OF TABLES

Table		Page
1	Drainage divisions and watershed units of Manitoba that contain the lakes surveyed	12
2	Morphometry of Night Owl, Horseshoe and Long lakes	13
3	Water chemistry analysis of the lakes - July 25, 1979	19
4	Small fish collected from Night Owl, Horseshoe and Long lakes	20
5	Gill net summary - Night Owl Lake	22
6	Gill net summary - Horseshoe Lake	23
7	Gill net summary - Long Lake	24
8	Age-specific mean fork lengths, weights and condition factors for walleye from Night Owl, Horseshoe and Long lakes	25
9	Age-specific mean fork lengths, weights and condition factors for northern pike from Night Owl, Horseshoe and Long lakes	27
10	Stomach contents of walleye and northern pike from the inventory lakes	29
11	MEI and estimated production potential (MSY) for Night Owl, Horseshoe and Long lakes	30
12	Trophic state of Night Owl, Horseshoe and Long lakes based on two parameters (Secchi disc and total phosphorus)	31

Table		Page
13	Mean biomass per mesh from inventory lakes on the east side of Lake Winnipeg	35
14	Estimated angling yield for Night Owl, Horseshoe and Long lakes based on moderate quality fisheries	37

LIST OF APPENDICES

Appendix		Page
1	Plankton and benthos collected from Night Owl Lake	46
2	Plankton and benthos collected from Horseshoe Lake	47
3	Plankton and benthos collected from Long Lake	49
4	Catch summary of net sets 1 to 6 made in Night Owl Lake	52
5	Catch summary of net sets 1 to 10 made in Horseshoe Lake	53
6	Catch summary of net sets 1 to 7 made in Long Lake	54
7	Temporal changes in mean length of walleye from Night Owl, Horseshoe and Long lakes	55
8	Temporal changes in mean length of northern pike from Night Owl, Horseshoe and Long lakes	56

INTRODUCTION

Night Owl, Horseshoe and Long lakes are presently only accessible by aircraft or canoe. This relative isolation will change as an expanding transportation network penetrates further into the area east of Lake Winnipeg.

The remote nature of the lakes on the east side of Lake Winnipeg ensures relatively light angler pressure. The results of the angling licence questionnaire in 1972 indicated 167,547 angling days spent in the East central portion of Manitoba. The 1981 angler survey indicated 216,172 angling days were spent in the same area. This is an increase of 22.5% in nine years. Most of the angling days were exerted by guests of lodges in the East Central area.

There is a private cabin located on Horseshoe Lake. There are no permanent structures on Night Owl or Long lakes.

This inventory was conducted from June 5 to June 19, 1979. The objectives were to determine the sport fish potential of the lakes and provide baseline data to permit development of an allocation and use strategy for recreational fisheries.

The Study Area

Night Owl, Horseshoe and Long lakes are located on the Berens River approximately 274 km northeast of Winnipeg (Fig. 1).

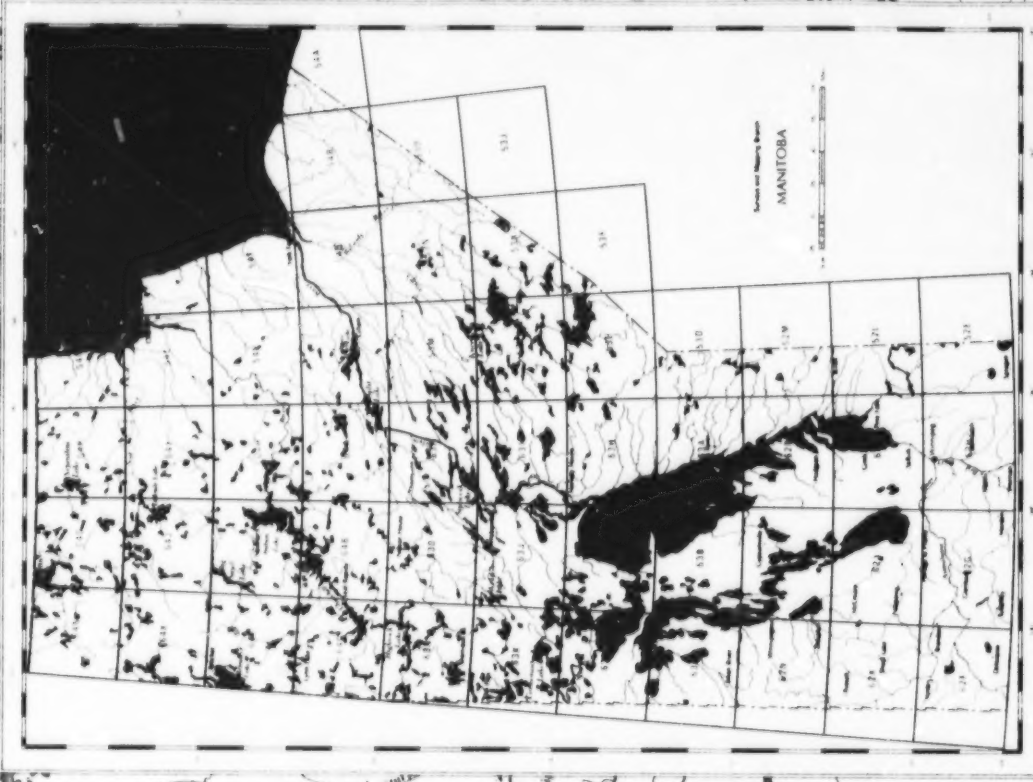
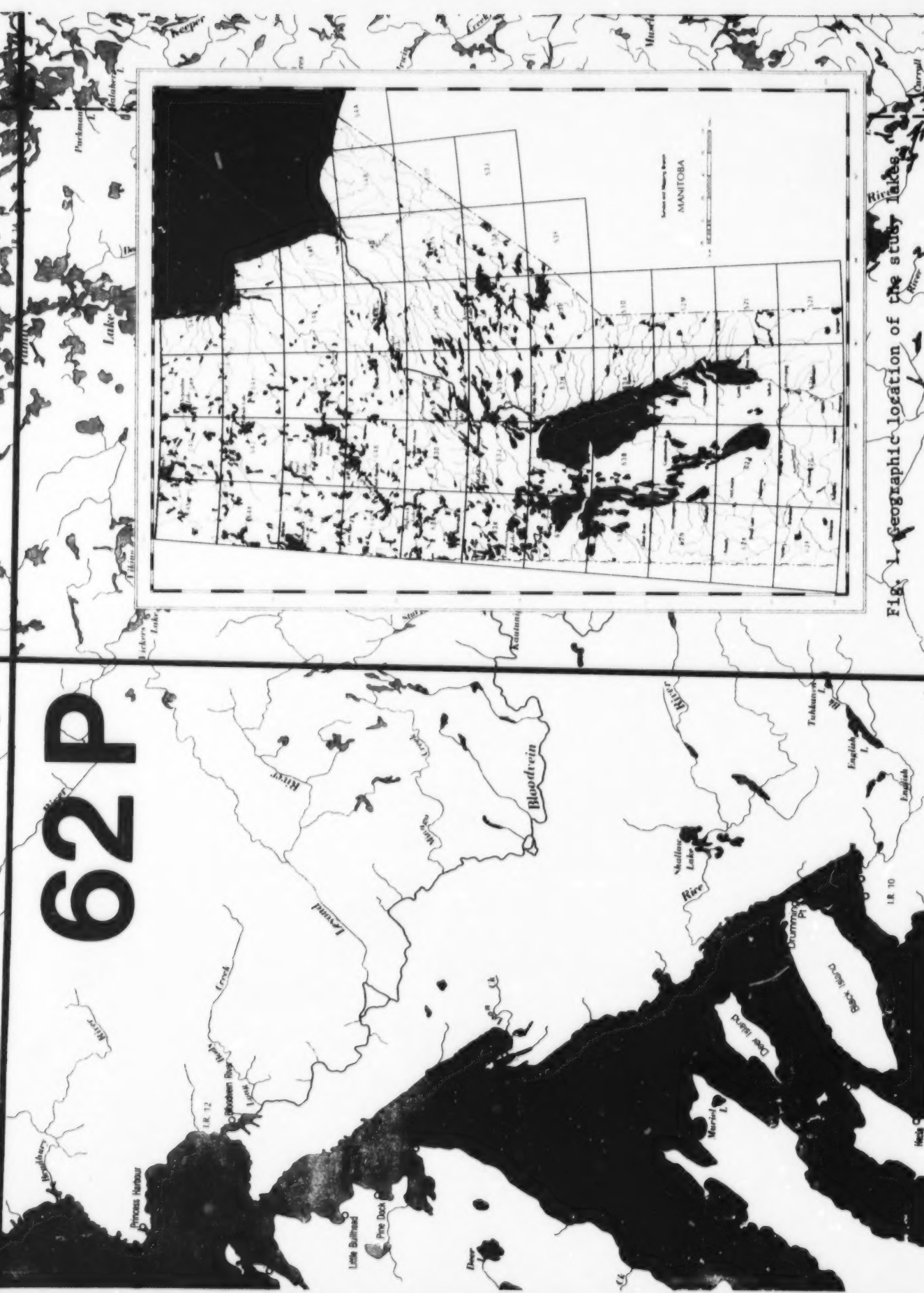
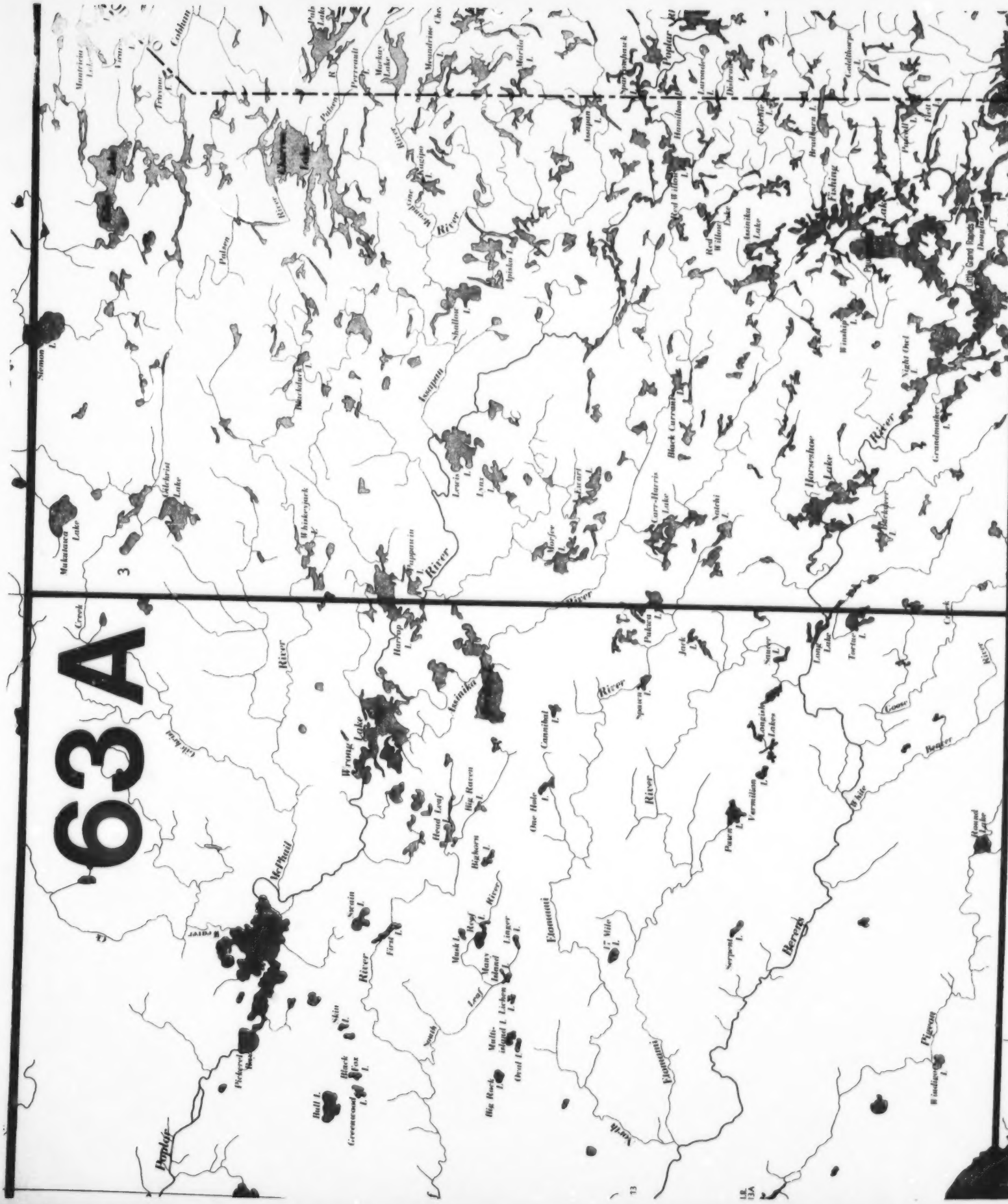


FIG. 1. Geographic location of the study lakes.

A 39

Their location by latitude (N) and longitude (W) are as follows:

Night Owl	52°06'	95°38'
Horseshoe	52°12'	95°49'
Long	52°12'	96°03'

All of the lakes are located on the Precambrian Shield.

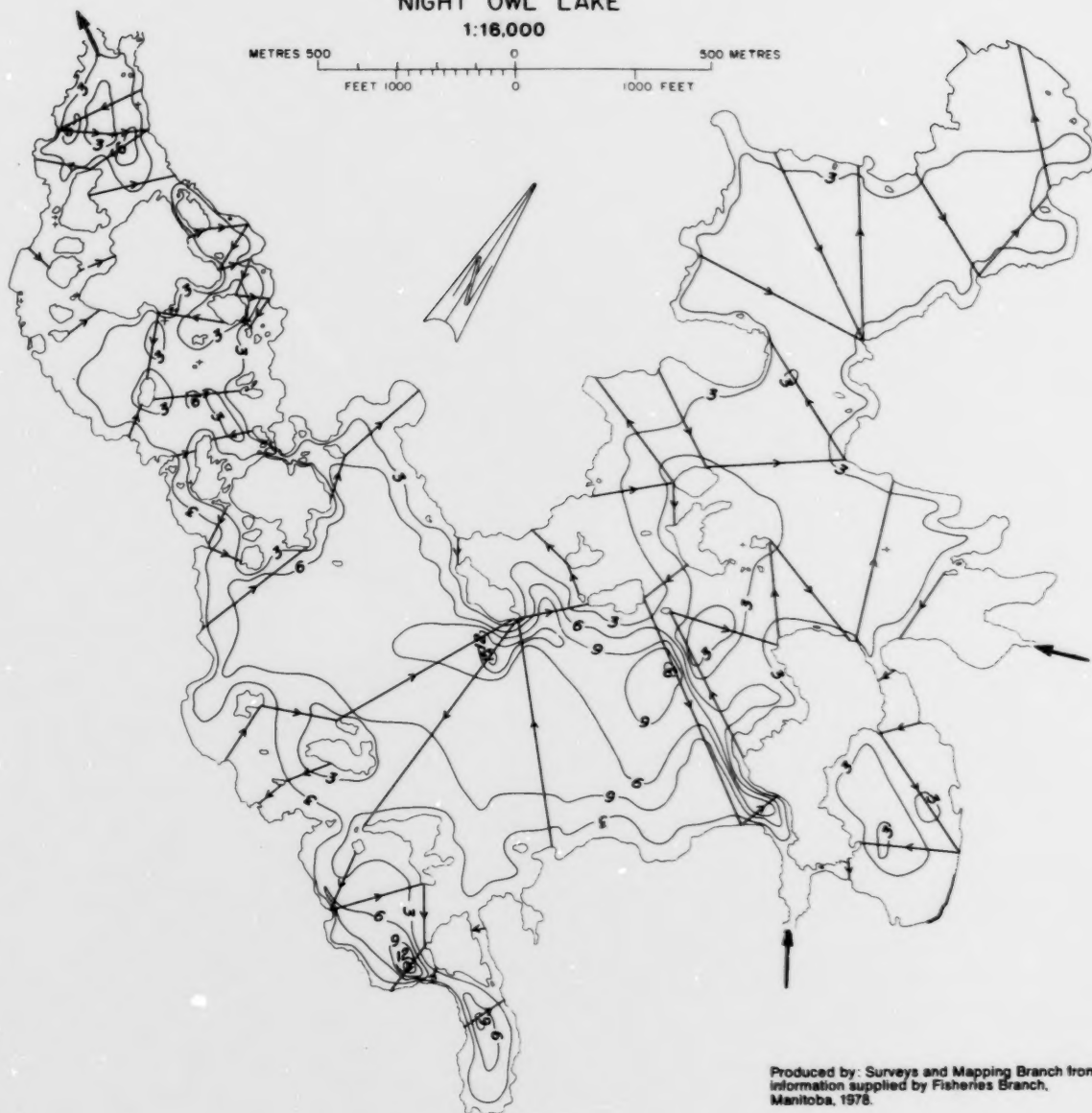
The topography of the area is Precambrian drift plain of a rolling to hilly nature. The surface deposits consist of varying amounts and thicknesses of glacial drift with abundant rock outcrop. Bogs and lakes cover 40 to 60% of the surface (Weir 1960). A more complete description of the geology and soil composition of the area may be obtained from Dutchak et al. (1978).

The natural vegetation of the area is northern coniferous forest consisting mainly of black spruce (Picea mariana), white spruce (Picea glauca) and balsam fir (Abies balsamea). There is jackpine (Pinus banksiana), white birch (Betula papyrifera) and balsam poplar (Populus balsamifera) in areas of recent burns (Weir 1960). A detailed mapping of the vegetation surrounding each lake may be obtained from the Forest Inventory section of the Department of Natural Resources.

The principal species of emergent vegetation in these lakes were yellow water-lily (Nuphar variegatum), floating leaf pondweed (Potamogeton natens), arrowhead (Sagittaria cuneata), bulrush (Scirpus sp) and reed grass (Phragmites communis). There were limited areas of emergent vegetation in Night Owl, Horseshoe and Long lakes.

Night Owl, Horseshoe and Long lakes are all headwater lakes of the Berens River. The drainage basin areas are Night Owl 642 km², Horseshoe 432 km² and Long 950 km². The principal inflow and outflow for each of the lakes is the Berens River. In addition Horseshoe Lake (Fig. 3) has six inflowing creeks draining outlying lakes and bog areas. Night Owl has one (Fig. 2) and Long Lake (Fig. 4) five additional inflowing creeks.

NIGHT OWL LAKE
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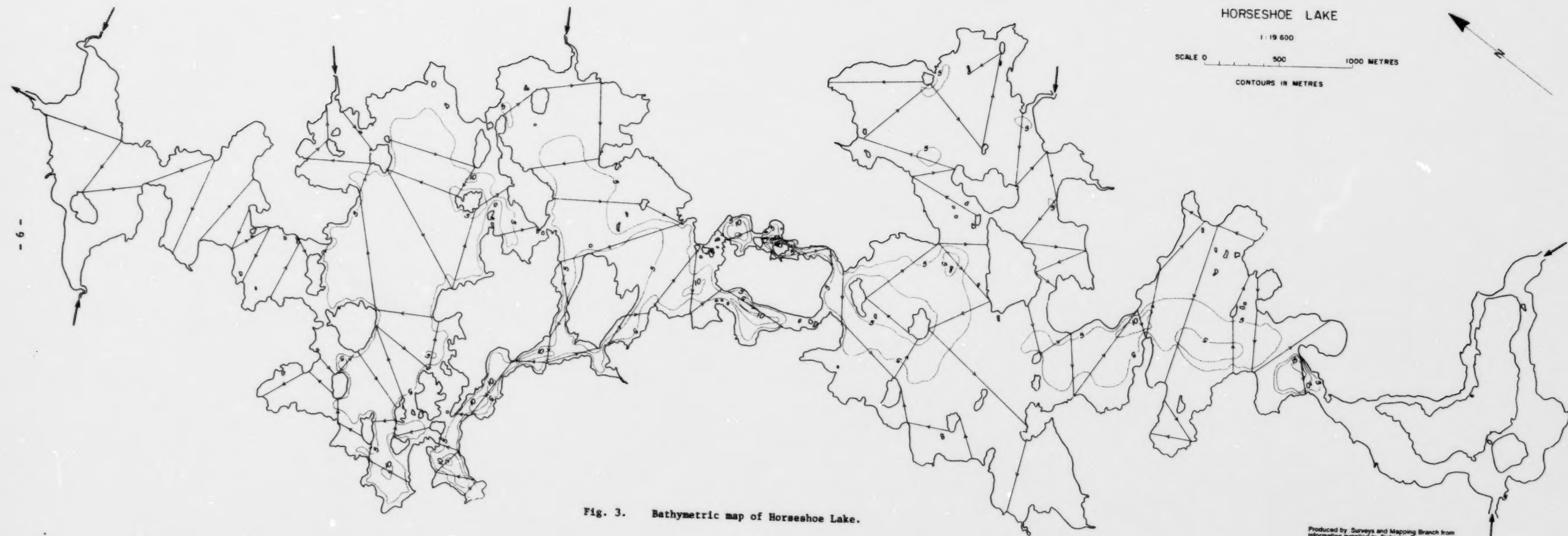


Fig. 3. Bathymetric map of Horseshoe Lake.

Produced by Surveys and Mapping Branch from
information supplied by Fisheries Branch,
Manitoba, 1975.

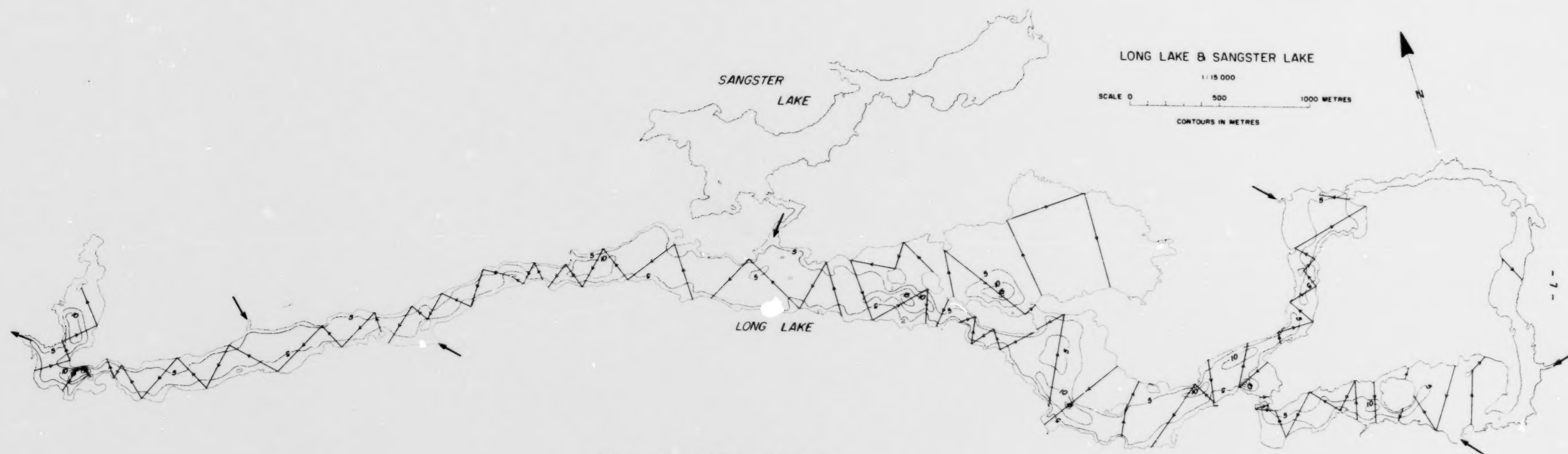


Fig. 4. Bathymetric map of Long Lake.

METHODS

Morphometry

The number of transects run for bathymetric mapping varied with each lake and was determined by the complexity of the lake basin. The depth sounding in this survey was done with a Furuno FG200 MK3 unit with a range of 0 to 87 meters. The unit was attached to a 4.3 meter inflatable boat powered by a 20 H.P. outboard. The locations of the transects were drawn on a work map prior to sounding. Some of the transects were later modified after substituting more prominent land marks for reference points. The completed bathymetric maps were used to determine lake area, volume, mean depth and shoreline development according to procedures described by Hutchinson (1957).

Physical and Chemical Parameters

The number of sampling locations for collection of physical and chemical parameters was not fixed and varied according to the complexity of the lake basin and the location of inflowing streams. At each location temperature, dissolved oxygen, conductivity and pH were recorded. The water temperature and dissolved oxygen profiles were recorded at one meter intervals from the surface to the bottom with a YSI electronic instrument. The transparency of the water was measured with a standard limnological Secchi disc, according to Welch (1948). Specific conductivity was measured at the surface with a YSI electronic instrument. The pH at each location

was measured with a Hach wide range colour comparator field kit.

The number of locations for collection of water samples for chemical analysis was two per lake. Two one litre and one 500 ml samples were collected from each station. The 500 ml sample was fixed with 2.5 ml nitric acid (50%). The samples were submitted for analysis within 24 hours of being collected. The analyses of the water samples were done by the Environmental Management Division of the Department of Environment.

Plankton

Plankton samples were collected at the water chemistry locations with a 24 cm diameter Wisconsin plankton net of 73µm Nitex. The samples were preserved in the field in 10% formalin. Identification of the plankton was made in the laboratory.

Benthos

Benthos samples were also collected from the water chemistry locations with a 15 cm by 15 cm Ekman dredge. The samples were washed in the field in a 400 µm Nitex bag and preserved in 10% formalin for later identification and analysis.

Fish

Small fish specimens (forage fish) were collected by seining a suitable area with a 1.2m by 7.4m minnow seine of

6mm oval mesh. These were supplemented with samples taken with the fish toxicant, rotenone. A small bay or area of the lake was selected, preferably one that could be blocked off with the seine, and 1 litre of rotenone was then gradually dispensed into the water in the prop wash. It was thoroughly mixed into the water by traversing the treated area by boat several times. The fish were picked up with a small dip net as they rose to the surface.

The sport species and other large fish were captured with standard gang gill nets. Each standard gang consisted of six gill nets with the mesh sizes in the following sequence: 3.8 cm, 9.5 cm, 5.1 cm, 10.8 cm, 7.6 cm and 12.7 cm. Each gill net in the standard gang was 22.9m long and 1.8m deep. The standard gang sets were rotated around the lake to sample as many different habitat types and depth zones as possible. The gangs were set overnight for approximately 16 hours. The numbers of fish captured in the gill nets were recorded. The sport species, walleye (Stizostedion vitreum) and northern pike (Esox lucius), were sampled for fork length, weight, sex, maturity and stomach contents. For age determination, the otoliths and first two dorsal spiny rays were taken from walleye and the first two pelvic rays were taken from the northern pike. All other species of fish were measured for fork length and weight only. Preparation and ageing of the otoliths and pelvic rays only were performed according to the procedures outlined by Erickson (1979).

Calculations

The morphoedaphic index (MEI) was calculated according to Ryder (1965). Procedures described by Snedecor and Cochran (1967) were followed for statistical analyses. The mean weighted age of onset of sexual maturity was calculated by the equation:

$$Z = \frac{A_1 K_1 + A_2 (K_2 - K_1) + A_3 (K_3 - K_2) + \dots + A_n (K_n - K_{n-1})}{K_1 + (K_2 - K_1) + (K_3 - K_2) + \dots + (K_n - K_{n-1})}$$

where A = age (years)

K_n = % of mature fish in the n^{th} age class. This is a corrected form of Abrasov's (1967) formula. The trophic state of the lakes was determined from the trophic state index (TSI) described by Carlson (1977).

RESULTS

Morphometry

The watershed divisions that contain the inventory lakes are summarized in Table 1. Also shown is the area of each watershed unit (Fedoruk 1970).

The morphometry of the lakes surveyed was fairly diverse. The shoreline development index ranged from 3.11 on Night Owl to 4.96 on Horseshoe Lake. The morphometry of the lakes is summarized in Table 2. Bathymetric maps of the lakes are presented in Figs. 2 to 4. All depth contours are in meters.

Table 1. Drainage divisions and watershed units of Manitoba that contain the lakes surveyed.

Principal Drainage Division			Major Drainage Division			Watershed Division			Lake
No.	Name	Approx. area in Manitoba in km ²	No.	Name	Approx. area in Manitoba in km ²	No.	Name	Approx. area in Manitoba in km ²	
5	Nelson River	313,131	5RD	Berens River lower division	7,933	5RD-J	Family Lake region	642	Night Owl
						5RD-H	Horseshoe Lake region	432	Horseshoe
						5RD-C	Berens River lower region	950	Long

Table 2. Morphometry of Night Owl, Horseshoe and Long lakes.

Measurement	Night Owl	Horseshoe	Long
Area (ha)	263	1131	300
Maximum depth (m)	15.0	15.0	15.0
Mean depth (m)	4.0	3.6	4.2
Volume ($m^3 \times 10^6$)	10.5	40.7	12.7
Length of shoreline (km)	17.9	59.2	28.5
Length of island shoreline (km)	9.6	35.4	9.1
Total length of shoreline (km)	27.5	94.6	37.6
Shoreline development index	3.11	4.96	4.64

Physical and Chemical Parameters

The Secchi disc transparencies (m) for each lake were as follows:

Night Owl	1.5	June 6, 1979
Horseshoe	1.5	June 13, 1979
Long	1.2	June 19, 1979

Temperature-dissolved oxygen profiles of Night Owl, Horseshoe and Long lakes showed each to be isothermal with saturated or near saturated levels of dissolved oxygen (Fig. 5). The locations of the sampling stations are illustrated in Figs. 6 to 8.

The average values for field measurements of pH and specific conductivity were close to the values obtained from the

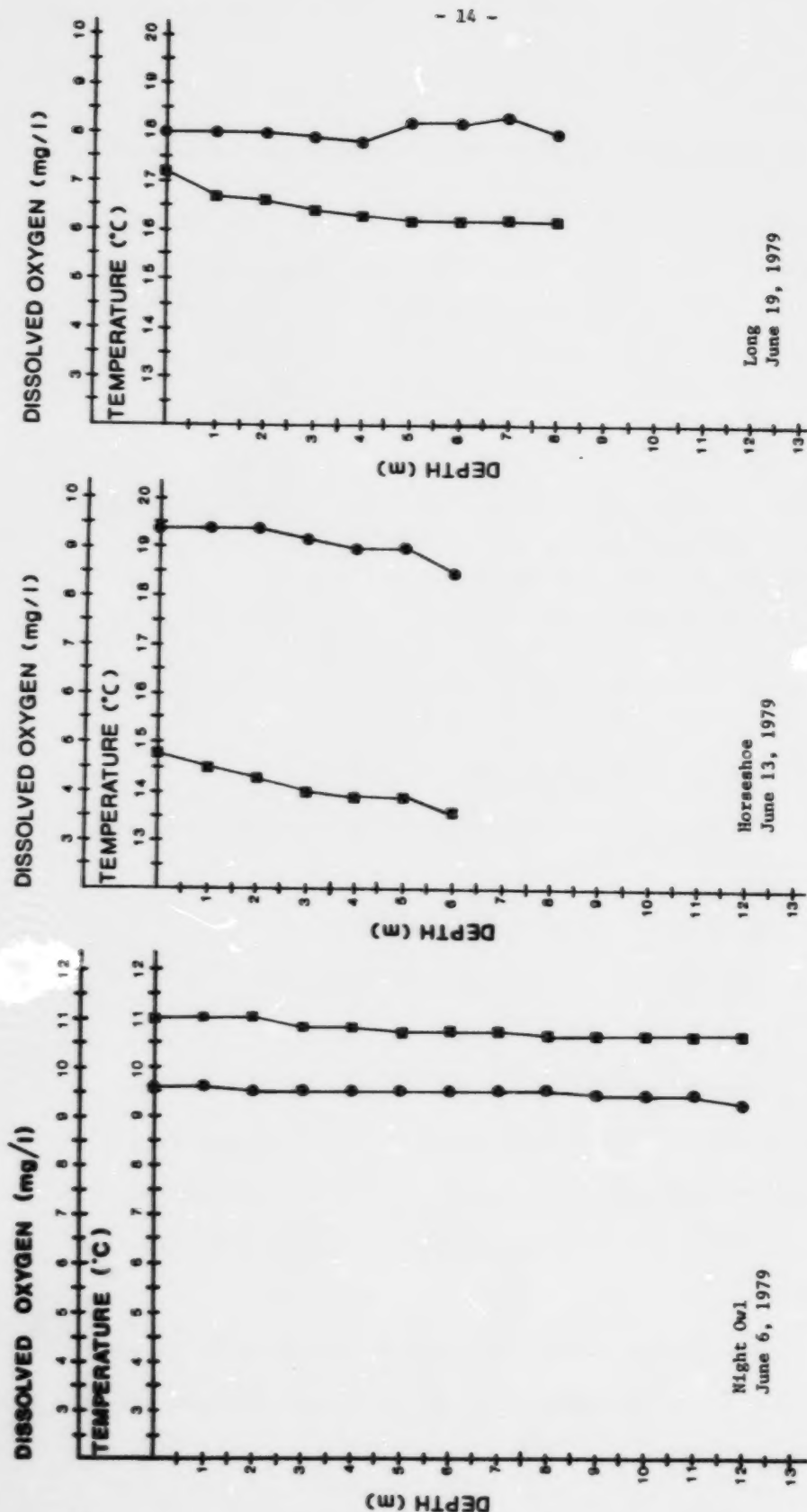


Fig. 5. Temperature —■—■ dissolved oxygen ●—● profiles of Night Owl, Horseshoe and Long lakes.

- 15 -
NIGHT OWL LAKE
1:16,000



Fig. 6. Locations of chemical stations and fish collection sites
in Night Owl Lake.

LEGEND
 △ Water Sample Stations
 ▲ Chemical Stations
 WW Gill Net Sets
 ○ Small Fish Collection Sites

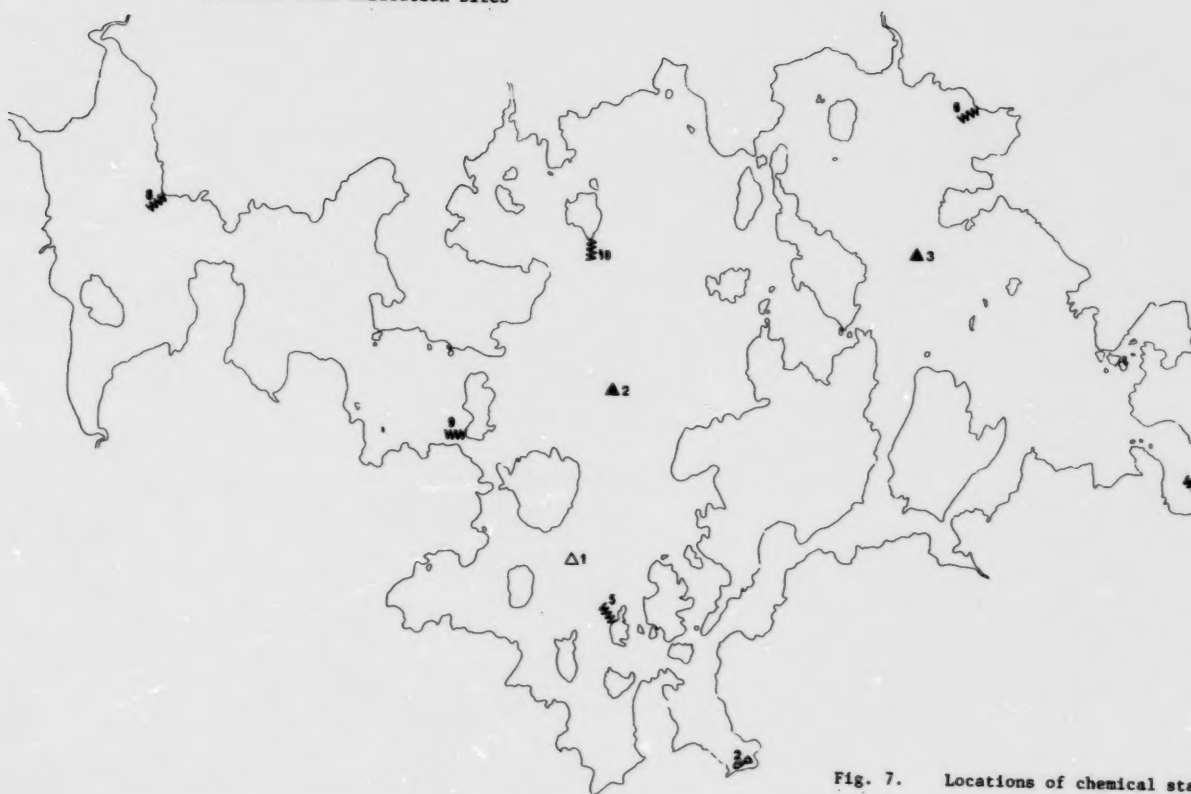


Fig. 7. Locations of chemical stations in Horseshoe Lake.

HORSESHOE LAKE

1960

SCALE 0

500

1000 METRES

CONTOURS 1M METRES



lons and fish collection sites

Produced by Surveys and Mapping Branch from
information supplied by Fisheries Branch
Manitoba 1975

LEGEND
△ Water Sample Stations
▲ Chemical Stations
WW Gill Net Sets
☞ Small Fish Collection Sites

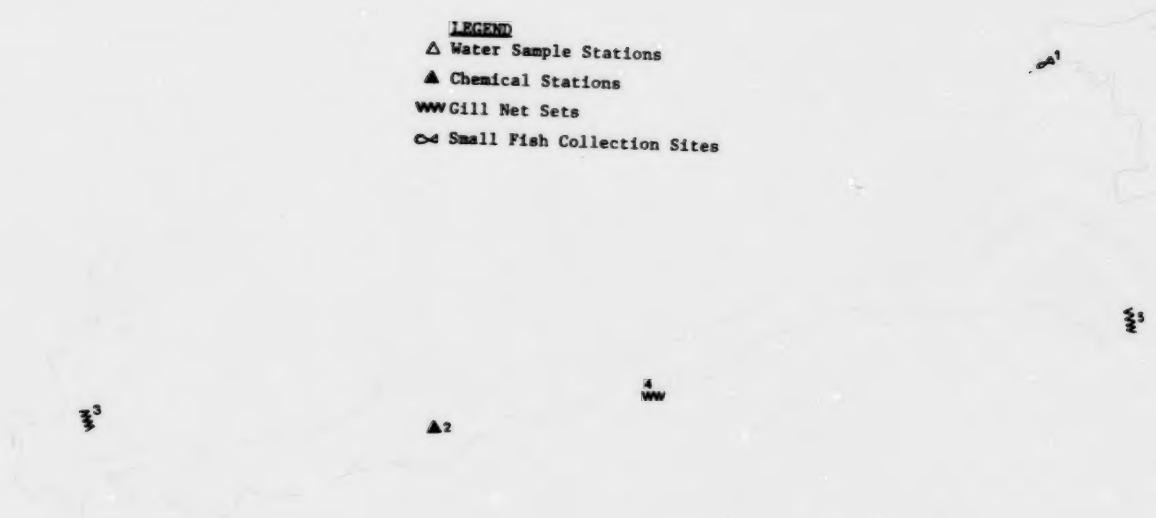


Fig. 8. Locations of chemical stations in Long Lake.



al stations and fish collection sites

lab analysis of the water samples (Table 3).

Dissolved minerals in these lakes were dominated by bicarbonates and sodium (Table 3). The specific conductivity ($\mu\text{mho/cm}$) only ranged from 48.8 in Night Owl to 49.5 in Long and the total dissolved solids were the same for each lake, 60.0 mg/l.

Nutrient concentrations of the lakes were quite low. The total dissolved nitrogen, nitrites and nitrates were <0.01 mg/l in each lake. The total phosphorus concentration was <0.02 mg/l in each lake (Table 3).

Plankton and Benthos

Although there were numerous genera of phytoplankton and zooplankton from each lake, there were only 11 genera of phytoplankton and 4 genera of zooplankton common to the inventory lakes. The results are given in Appendices 1 to 3.

Fish

Ten species of small fish were collected from Night Owl, Horseshoe and Long lakes during this inventory. The most abundant species common to each lake were spottail shiners (Notropis hudsonius). The most abundant species within a lake were mimic shiners (Notropis volucellus) in Horseshoe Lake. A summary of the species captured is presented in Table 4. The sampling locations are shown in Figs. 6 to 8.

Table 3. Water chemistry analysis of the lakes - July 25, 1979.

	Night Owl	Horseshoe	Long
Conductivity (Field) (μ mhos/cm)	33.0 @ 11.4C	38 @ 19.1C	33 @ 16.7C
Conductivity (Lab) (μ mhos/cm)	48.8	48.9	49.5
Residue Total (mg/l)	60.0	60.0	60.0
Residue (Filterable) (mg/l)	60.0	60.0	60.0
Residue (Nonfilterable) (mg/l)	<5.0	<5.0	<5.0
pH (Field)	7.0	7.0	6.8
pH (Lab)	7.2	7.3	7.2
Alkalinity (Total) CaCO_3 (mg/l)	20.0	24.0	20.0
Alkalinity (HCO_3^-) (mg/l)	24.4	29.3	24.4
Alkalinity (CO_3^{2-}) (mg/l)	0.0	0.0	0.0
Alkalinity (OH) (mg/l)	0.0	0.0	0.0
Calcium (Ext) (mg/l)	7.0	5.0	7.0
Magnesium (Ext) (mg/l)	<5.0	<5.0	<5.0
Hardness (CaCO_3) (mg/l)	<39.0	<34.0	<39.0
Manganese (Ext) (mg/l)	<0.02	<0.02	<0.02
Iron (Ext) (mg/l)	0.15	0.24	<0.55
Potassium (Ext) (mg/l)	<2.0	<2.0	<2.0
Sodium (Ext) (mg/l)	<10.0	<10.0	<10.0
Total Organic Carbon (mg/l)	15.0	15.5	14.5
Total Inorganic Carbon (mg/l)	4.0	4.0	3.5
Colour (True 0-50 units)	50.0	50.0	50.0
Turbidity (NTU)	0.90	0.90	1.5
Total Kjeldhal N (mg/l)	0.40	0.40	0.40
$\text{NO}_3^- - \text{NO}_2^- - \text{N}$ (Diss) (mg/l)	<0.01	<0.01	<0.01
Total Phosphorus (mg/l)	<0.02	<0.02	<0.02
Chlorine (Sol) (mg/l)	<2.0	<2.0	<2.0
Sulfate (Sol) (mg/l)	8.0	8.0	8.0

Table 4. Small fish collected from Night Owl, Horseshoe and Long lakes.

Species	Number of fish from -		
	Night Owl	Horseshoe	Long
Brook stickleback (<u>Culaea inconstans</u>)	117	-	-
Johnny darter (<u>Etheostoma nigrum</u>)	15	20	-
Spottail shiner (<u>Notropis hudsonius</u>)	115	61	2
Mimic shiner (<u>Notropis volucellus</u>)	39	206	-
Northern pike (<u>Esox lucius</u>)	2	-	11
Yellow perch (<u>Perca flavescens</u>)	8	4	2
Rock bass (<u>Ambloplites rupestris</u>)	-	1	-
Slimy sculpin (<u>Cottus cognatus</u>)	-	8	-
Nine-spine stickleback (<u>Pungitius pungitius</u>)	-	2	-
Emerald shiner (<u>Notropis atherinoides</u>)	-	60	30

A total of 23 standard gangs were set in Night Owl, Horseshoe and Long lakes. There were 6 gangs set in Night Owl, 11 in Horseshoe and 7 in Long Lake. These produced ten species of fish, the most abundant species in each lake being northern pike. The catches of the standard gangs are summarized in terms of number and total weight per mesh size in Tables 5 to 7. The locations of the standard gang sets are illustrated in Figs. 6 to 8. Catch summaries for each net set for each lake are presented in Appendices 4 to 6.

Walleye Age and Growth

The age-specific mean fork lengths, weights and condition factors for walleye from Night Owl, Horseshoe and Long lakes are presented in Table 8. The small sample size of walleye from each of the lakes does not permit an accurate representation of age-frequency distributions (Fig. 9), length-age relationships (Appendix 7) or maturity regimes of the walleye populations from the lakes.

Northern Pike Age and Growth

The age-specific mean fork lengths, weights and condition factors for northern pike from Night Owl, Horseshoe and Long lakes are presented in Table 9. The small sample size of northern pike from each lake does not permit an accurate representation of the age-frequency distributions (Fig. 10), length-age relationships (Appendix 8) or maturity regimes of the northern pike populations

Table 5. Gill net summary - Night Owl Lake.

Species	Mesh size (cm)										Total	%
	3.81	5.08	7.62	9.52	10.79	12.70	14.63	17.3	20.0	22.9		
Walleye (<u>Stizostedion vitreum</u>)	No. kg.	1 0.9	2 0.3	5 5.3	2 1.9	4 4.7	-	14 13.1	17.3			
Northern pike (<u>Esox lucius</u>)	No. kg.	1 1.5	1 0.8	12 12.9	9 15.8	4 5.5	-	27 36.5	33.4			
Sauger (<u>Stizostedion canadense</u>)	No. kg.	-	3 0.8	1 0.3	-	-	-	4 1.0	4.9			
Yellow perch (<u>Perca flavescens</u>)	No. kg.	6 0.3	1 0.1	-	-	-	-	7 0.4	8.6			
Tullibee (<u>Coregonus artedii</u>)	No. kg.	-	4 0.7	10 4.9	5 4.2	5 3.4	1 1.2	25 14.4	30.9			
White sucker (<u>Catostomus commersoni</u>)	No. kg.	-	-	1 0.5	-	-	-	1 0.5	1.2			
Mooneye (<u>Hiodon tergisus</u>)	No. kg.	-	-	-	1 0.4	1 0.6	-	2 1.0	2.5			
Rock bass (<u>Ambloplites rupestris</u>)	No. kg.	-	-	1 0.2	-	-	-	1 0.2	1.2			
Total	No. kg.	8 2.7	11 2.6	30 24.1	17 22.3	14 14.2	1 1.2	81 67.3				
Mean no. walleye/mesh		0.2	0.3	0.8	0.3	0.7	-					
Mean no. pike/mesh		0.2	0.2	2.0	1.5	0.7	-					
Mean no. fish/mesh		1.3	1.8	5.0	2.8	2.3	0.2	13.5				
Mean biomass/mesh		0.4	0.4	4.0	3.7	2.4	0.2	11.2				

Table 6. Gill net summary - Horseshoe Lake.

Species	Mesh Size (cm)							Total	%
	3.81	5.08	7.62	9.52	10.79	12.70			
Northern pike (<u>Esox lucius</u>)	No. 9	9	23	10	1	-	52	30.8	
	kg. 10.2	20.7	36.9	23.0	1.7	-	87.5		
Walleye (<u>Stizostedion vitreum</u>)	No. 2	9	6	-	-	1	18	10.6	
	kg. 0.2	3.4	3.5	-	-	1.9	90		
Yellow perch (<u>Perca flavescens</u>)	No. 9	7	-	-	-	-	16	9.5	
	kg. 0.4	0.6	-	-	-	-	1.0		
Mooneye (<u>Hiodon tergisus</u>)	No. -	7	23	8	-	-	38	22.5	
	kg. -	0.9	8.0	3.7	-	-	12.6		
Tullibee (<u>Coregonus artedii</u>)	No. -	1	7	-	1	-	9	5.3	
	kg. -	0.3	2.6	-	0.6	-	3.5		
White sucker (<u>Catostomus commersoni</u>)	No. -	-	-	5	5	6	16	9.5	
	kg. -	-	-	4.7	5.7	9.5	19.9		
Shorthead redhorse (<u>Moxostoma macrolepidotum</u>)	No. -	-	-	3	3	1	7	4.1	
	kg. -	-	-	2.9	3.3	1.4	7.6		
Sauger (<u>Stizostedion canadense</u>)	No. 3	6	-	-	-	-	9	5.9	
	kg. 0.5	1.1	-	-	-	-	1.6		
Whitefish (<u>Coregonus clupeaformis</u>)	No. -	-	-	-	1	1	2	1.2	
	kg. -	-	-	-	2.3	1.8	4.1		
Rock bass (<u>Ambloplites rupestris</u>)	No. -	-	1	-	-	-	1	0.6	
	kg. -	-	0.2	-	-	-	0.2		
Total	No. 23	39	60	26	11	9	168		
	kg. 11.3	27.0	46.2	34.3	13.6	14.6	147.0		
Mean no. walleye/mesh	0.2	0.9	0.6	-	-	0.1			
Mean no. pike/mesh	0.9	0.9	2.3	1.0	0.1	-			
Mean no. fish/mesh	2.3	3.9	6.0	2.6	1.2	0.9	16.9		
Mean biomass/mesh	1.1	2.7	4.6	3.4	1.4	1.5	14.7		

Table 7. Gill net summary - Long Lake.

Species	Mesh size (cm)								Total %
	3.81	5.08	7.62	9.52	10.79	12.70			
Northern pike (<u>Esox lucius</u>)	No. kg.	2 0.1	6 11.5	15 37.7	4 13.8	1 2.0	-	28 65.1	33.3
Walleye (<u>Stizostedion vitreum</u>)	No. kg.	-	1 0.1	3 1.9	1 2.1	1 0.9	-	6 5.0	7.1
Yellow perch (<u>Perca flavescens</u>)	No. kg.	2 0.07	2 0.1	-	-	-	-	4 0.17	4.8
Mooneye (<u>Hiodon tergisus</u>)	No. kg.	-	9 1.9	17 5.7	11 4.7	-	-	37 12.3	44.1
Tullibee (<u>Coregonus artedii</u>)	No. kg.	-	-	-	3 2.0	-	1 1.1	4 3.1	4.8
Shorthead redhorse (<u>Moxostoma macrolepidotum</u>)	No. kg.	-	-	-	1 0.6	1 1.1	-	2 1.7	2.4
White sucker (<u>Catostomus commersoni</u>)	No. kg.	1 0.05	-	-	-	1 0.7	-	2 0.75	1.1
Sauger (<u>Stizostedion canadense</u>)	No. kg.	-	-	-	1	0.6	-	1 0.6	
Total	No. kg.	5 0.2	18 13.6	35 45.3	21 23.8	4 4.7	1 1.1	84 88.72	
Mean no. walleye/mesh		-	0.1	0.4	0.1	0.1	-		
Mean no. pike/mesh		0.3	0.8	2.1	0.6	0.1	-		
Mean no. fish/mesh		0.7	2.6	5.0	3.0	0.6	0.1	12.0	
Mean biomass/mesh		0.03	1.9	6.5	3.4	0.7	0.2	12.7	

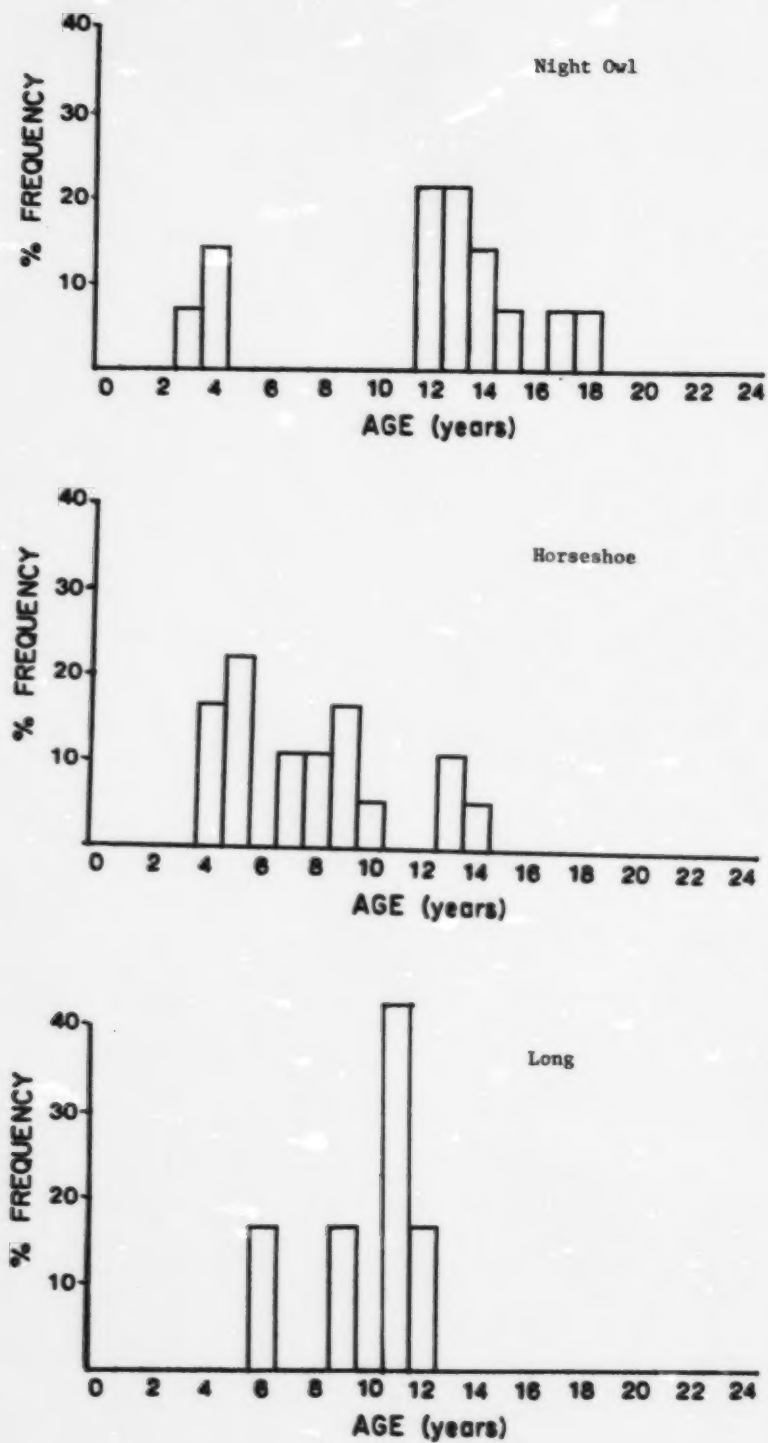


Fig. 9. Age-frequency distributions for walleye from Night Owl, Horseshoe and Long lakes.

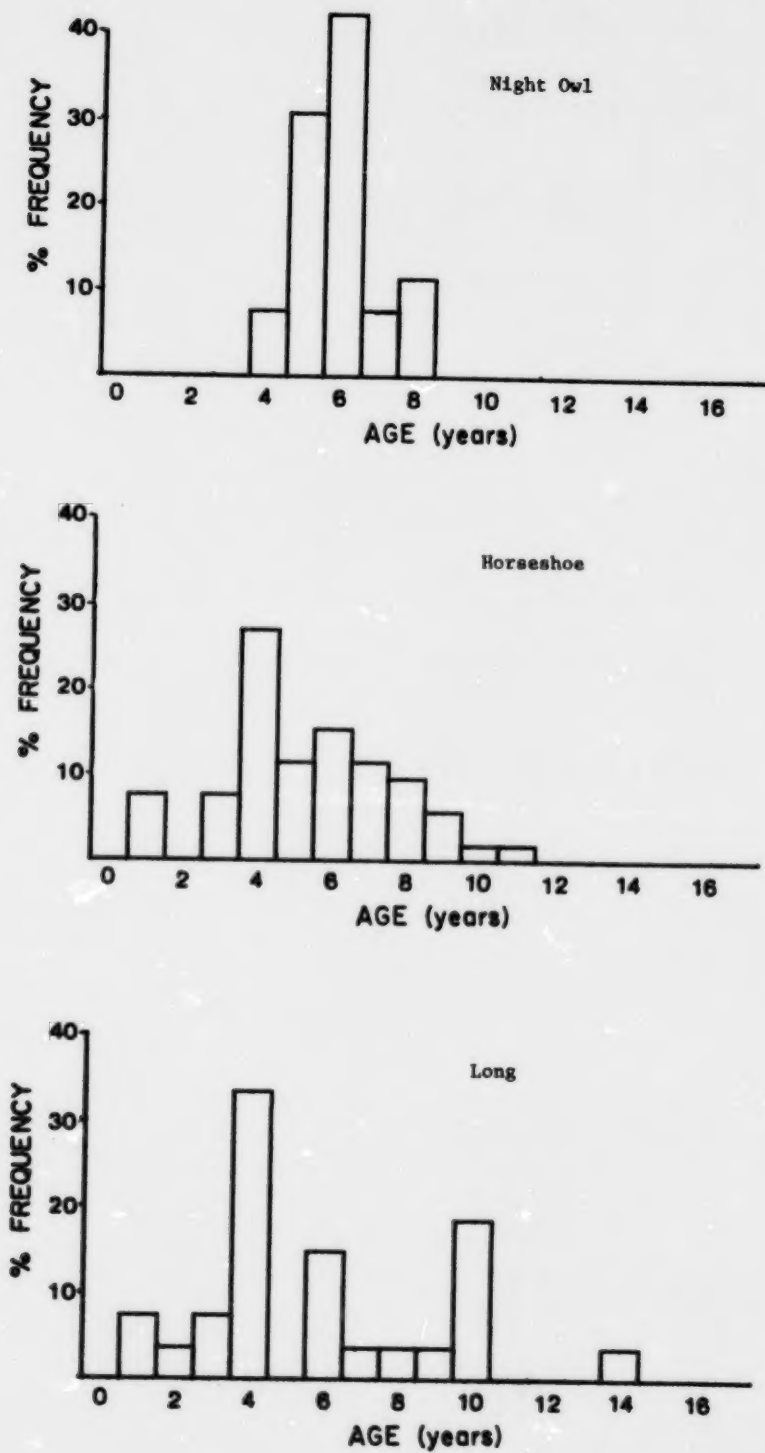


Fig. 10. Age-frequency distributions for northern pike from Night Owl, Horseshoe and Long lakes.

Table 10. Stomach contents of walleye and northern pike from the inventory lakes.

	Night Owl		Horseshoe		Long	
	Walleye %	N. Pike %	Walleye %	N. Pike %	Walleye %	N. Pike %
Number examined	14	27	18	52	6	28
Empty	2	9	6	32	2	16
Fish						
Emerald shiner	-	-	-	-	-	3.6
Yellow perch	-	-	-	7.7	-	7.1
Walleye	-	11.1	-	1.9	-	3.6
Tullibee	-	3.7	-	3.8	-	3.6
Slimy sculpin	-	-	-	1.9	-	-
Sauger	-	-	-	1.9	-	-
Ninespine stickleback	-	-	-	1.9	-	-
Trout perch	-	3.7	-	-	-	-
White sucker	-	3.7	-	-	-	-
Mooneye	-	-	-	-	-	-
Unidentified fish remains	7.1	18.6	22.2	13.6	16.7	7.1
Invertebrates						
Trichoptera	57.2	14.8				
Odonata				1.9		14.3
Ephemeroptera			27.8	1.9		-
Hirudinea			5.6			-
Decapoda	7.1	11.1		1.9		3.6
Unidentified invertebrate remains	14.3		11.1		16.7	-

from these lakes.

Stomach Contents

The stomach contents analysis conducted on the walleye and northern pike sampled from the inventory lakes showed fish to be most prevalent diet item. Of the identifiable remains, mooneye were the most numerous (Table 10).

Production Potential

The morphoedaphic index (MEI) described by Ryder (1965) was used to provide an estimate of the maximum sustained yield (MSY) of the inventory lakes. The derived potential yields are given in Table 11.

Table 11. MEI and estimated production potential (MSY) for Night Owl, Horseshoe and Long lakes.

Lake	Mean depth (m)	T.D.S. (mg/l)	MEI	Potential yield (kg/ha/yr)
Night Owl	4.0	60.0	15.0	4.9
Horseshoe	3.6	60.0	16.7	5.2
Long	4.2	60.0	14.3	4.9

According to Adams and Olver (1977) the MEI for each of the lakes is in the eutrophic range. A more realistic determination of the trophic state of the lakes may be obtained by using the trophic state index (TSI) described by Carlson (1977). Based on

a TSI range of 0 - 100, Night Owl, Horseshoe and Long lakes at approximately 50 would be considered mesotrophic (Table 12).

Table 12. Trophic state of Night Owl, Horseshoe and Long lakes based on two parameters (Secchi disc and total phosphorus).

Lake	Secchi disc	TSI	Total Phosphorus (mg/m ³)	TSI
Night Owl	1.5	54.2	20	47.4
Horseshoe	1.5	54.2	20	47.4
Long	1.2	57.4	20	47.4

DISCUSSION

Morphometry

The morphometries of Night Owl, Horseshoe and Long lakes are typical of Precambrian Shield lakes. The shorelines were predominantly rock with few sand beaches or flooded marshes. Sandy beach areas and shallow areas of rooted vegetation are important nursery and feeding areas for minnows and young-of-the-year yellow perch (Shupp 1978; Clady and Nielson 1978). The absence of flooded marshes may be a factor regulating the abundance of yellow perch and northern pike. Yellow perch characteristically spawn over submerged vegetation and brush (Ney 1978) and northern

pike characteristically spawn over flooded marsh vegetation and flat meadows covered by spring flood waters (Toner and Lawler 1969).

The limited amount of these habitat types may also have an effect on the abundance of walleye in these lakes as prey abundance has been shown to have an effect on walleye recruitment and growth (Forney 1977). Young-of-the-year yellow perch have been shown to be the preferred diet item of walleye in many lakes in the northern and central regions of walleye distribution (Colby et al. 1979).

It has been reported by Olson et al. (1978) that walleye eggs and fry drift far from the hatching area. It is possible the spring discharge of the Berens River is great enough to flush the walleye fry downstream, perhaps all the way to Lake Winnipeg. The upstream migration of adult spawning walleye from Lake Winnipeg would be restricted by natural barriers along the Berens River (falls and rapids) and fishing pressure from the community of Berens River. It is quite likely very few adults would make it back up the Berens River as far as Long Lake, let alone Horseshoe and Night Owl lakes.

Physical and Chemical Parameters

Temperature profiles for Night Owl, Horseshoe and Long lakes are considerably lower than the 20 C physiological optimum described by Hokanson (1977) for temperate mesotherm fishes. This was probably due to a late break up and cool weather as a warming trend is evident with each lake (Night Owl 11 C on June 6 to Long 17 C on June 19). It would appear then, that the reduced growing season of the area (June to September) would have a greater effect on the growth of the fish populations

than summer extremes of water temperature.

The water chemistry data from Night Owl, Horseshoe and Long lakes showed little spatial variation (Table 3). The values for specific conductance, total dissolved solids, nitrogen and phosphorus are similar to other Precambrian lakes on the east side of Lake Winnipeg (Hagenson and O'Connor 1980, 1981). The ionic composition was also similar to that described by Armstrong and Schindler (1971) for dilute Canadian Shield lakes.

Fish

The age-frequencies of the walleye and northern pike populations from Night Owl, Horseshoe and Long lakes (Figs. 9 and 10), showed significant numbers of older individuals. This would indicate that there has been no cropping of the older larger fish, due to excessive angler pressure. However, due to the small sample size for both walleye and northern pike, the data should be interpreted with caution.

The small number of walleye and northern pike captured in these lakes prevents an accurate representation of their growth or maturity characteristics. However, the age-specific mean lengths of walleye and northern pike from Night Owl, Horseshoe and Long lakes were similar to the age-specific mean lengths of walleye and northern pike populations from other lakes on the east side of Lake Winnipeg (Hagenson and O'Connor 1980, 1981). Comparing mean biomass per mesh from Night Owl, Horseshoe and Long lakes to other lakes on the east

side of Lake Winnipeg (Table 13) shows Vickers Lake to be quite comparable. Vickers Lake is located on the Pigeon River and is very similar in morphometry to Night Owl, Horseshoe and Long lakes (Hagenson and O'Connor 1980). Fish immigration and emigration is limited by extensive rapids above and below Vickers Lake. The total biomass it can support is restricted to the basin of the lake itself, as is the case with Night Owl, Horseshoe and Long lakes. Vickers, Night Owl, Horseshoe and Long lakes contain the critical species components and associated species detailed by Ryder and Kerr (1978) for a harmonic percoid community in the boreal forest zone, a characteristic of which is high community integrity resulting in stability of biomass.

The method of predicting angling yield described by Ryder et al. (1974) was employed to provide an estimate of the angling yield potential of Night Owl, Horseshoe and Long lakes (Table 14). The equation ($Y = 0.492 X^{0.673}$) was derived from a linear regression of MEI versus angling yield for Nutimik, Caddy, White, Betula, Eleanor, Falcon, Brereton, Jessica and Lone Island lakes in the Whiteshell (Fig. 11).

Table 13. Mean biomass per mesh (kg) from inventory lakes on the east side of Lake Winnipeg.

Lake	Mesh						Total
	3.81	5.08	7.62	9.52	10.79	12.70	
Night Owl	0.4	0.4	4.0	3.7	2.4	0.2	11.2
Horseshoe	1.1	2.7	4.6	3.4	1.4	1.5	14.7
Long	0.03	1.9	6.5	3.4	0.7	0.2	12.7
Morfee ¹	0.3	3.0	6.9	3.0	2.6	0.7	16.6
Ewart ¹	3.0	2.1	2.5	3.9	2.8	0.4	14.7
Lynx ¹	1.2	2.5	8.5	4.1	3.9	3.1	23.3
Carr-Harris ¹	1.7	1.8	3.2	1.9	3.8	0.4	12.8
Harrop ²	1.8	6.3	12.2	8.7	4.5	1.9	35.4
Eardley ²	2.2	4.5	9.7	5.7	4.6	1.6	28.3
Weaver ²	3.7	7.3	16.8	11.4	10.5	3.4	53.1
Wrong ²	1.8	6.3	15.9	9.7	9.8	5.3	48.9
Dogskin ³	1.9	7.2	18.9	13.5	7.1	4.4	53.0
Family ³	1.5	3.8	13.9	5.7	4.9	1.9	31.9
Viking ³	2.8	4.8	9.1	7.7	5.0	1.8	31.3
Vickers ³	0.9	1.2	6.8	4.4	2.6	0.7	16.6
Obukowin ⁴	0.9	4.1	10.3	7.9	3.2	2.1	29.8
Aikens ⁴	1.0	0.8	5.1	3.5	2.2	1.9	14.6

¹Hagenson 1983

²Hagenson & O'Connor 1981

³Hagenson & O'Connor 1980

⁴Hagenson & O'Connor 1979

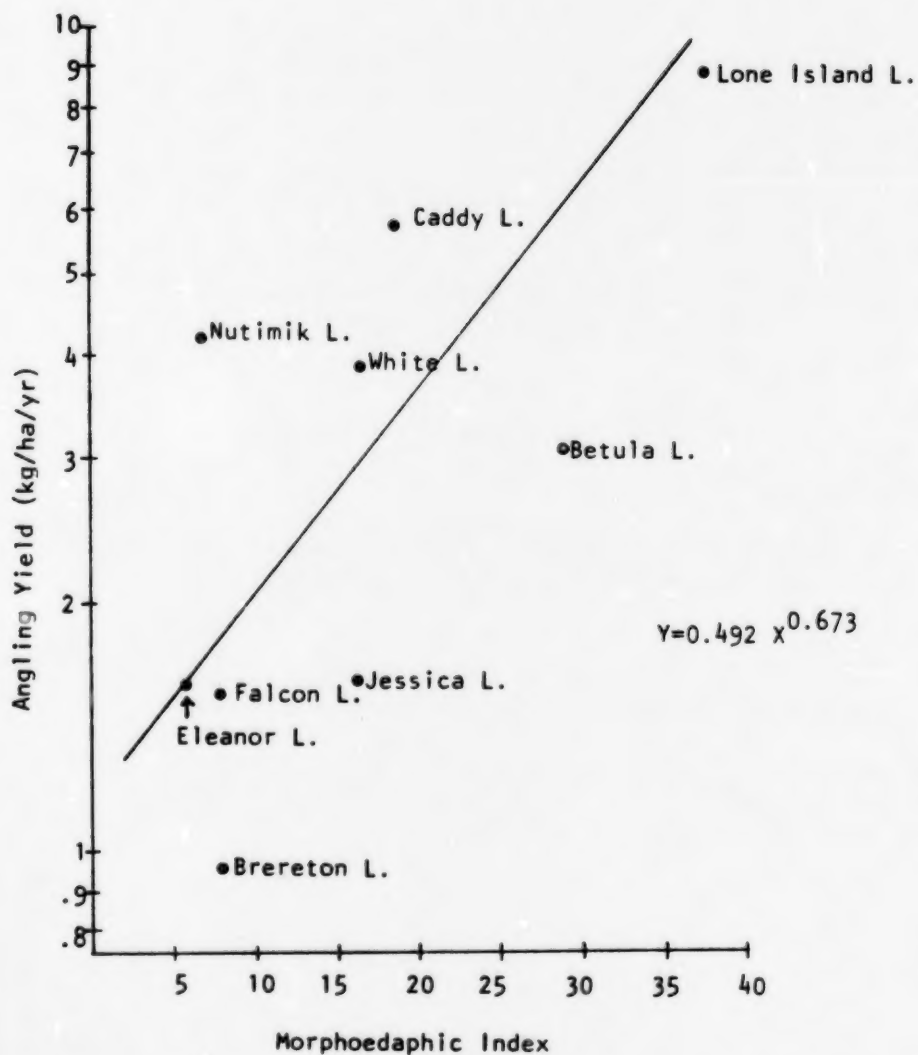


Fig. 11. Angling yield related to the morphoedaphic index for a relatively homogenous group of Precambrian lakes in the Whiteshell Provincial Park.

Table 14. Estimated angling yield for Night Owl, Horseshoe and Long lakes based on moderate quality fisheries.

Lake	MEI	Estimated angling yield kg/ha/yr
Night Owl	15.0	3.04
Horseshoe	16.7	3.27
Long	14.3	2.95

The preceding estimates of angling yield were based on the moderate quality sport fisheries which exist on developed Whiteshell lakes. The data from this inventory suggests the potential angling yield for Night Owl, Horseshoe and Long lakes would be limited to moderate quality.

An examination of the Manitoba Master Angler Awards from 1972 to 1979 shows only two awards for walleye from Horseshoe Lake. There were no awards for walleye or northern pike from Night Owl and Long lakes. The minimum qualifying weight is 3.6 kg for walleye and 9.0 kg for northern pike. It would appear the walleye population of Horseshoe Lake offers limited trophy potential.

MANAGEMENT IMPLICATIONS

Night Owl, Horseshoe and Long lakes are small lakes on the Precambrian Shield and are low in productive capacity. The results of this inventory indicate they have a small standing crop of fish and are probably at their climax capacity. It is therefore,

highly unlikely a stock enhancement program such as stocking would improve the angling potential offered by these lakes.

The limited angling potential offered by the walleye and northern pike populations make them unattractive as lodge lakes. However, the limited trophy potential of the Horseshoe Lake walleye population may make it a suitable outcamp lake.

Creel census data from the east side of Lake Winnipeg has shown the average angler harvest per day to be 5.44 kg (Jardine and Sigurdson 1981; D. Fitzjohn pers. comm., Manitoba Dept. of Nat. Res.). The potential yield of a lake, determined by Ryders morphoedaphic index may be partitioned into individual species yields, 32% for walleye and 25% for northern pike for sport fisheries (SPOF Working Group No. 12). For a moderate quality self-sustaining sport fishery no more than 57% of the MSY should be harvested. The average occupancy rate of lodges on the east side of Lake Winnipeg over a 120 day season is 45% (C. Wall, pers. comm., Manitoba Dept. of Nat. Res.). Combining this information into the following formula (J. O'Connor, pers. comm., Manitoba Dept. of Nat. Res.) provides an estimate of the number of beds these lakes can support for a moderate quality sport fishery.

$$\text{No. beds} = \frac{\text{MSY} \times .57 \times \text{Area}}{\text{H} \times \text{S} \times \text{O}}$$

$$\text{H} \times \text{S} \times \text{O}$$

where H = Harvest 5.44 kg

S = Season 120 days

O = Occupancy rate 45%

This equation predicts that outcamps of the following size could be considered for these lakes.

Night Owl	2
Horseshoe	10
Long	2

Since a two bed operation would not be economically viable, Horseshoe Lake is the only one with any development potential.

RECOMMENDATIONS

1. Night Owl, Horseshoe and Long lakes should be left as undeveloped wilderness lakes, no lodges should be considered for these lakes.
2. If Horseshoe Lake was considered for development, it should be as an outcamp lake and the capacity should not exceed 10 beds.

ACKNOWLEDGEMENTS

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Appendix 1. Plankton and benthos collected from Night Owl Lake.

CYANOPHYTA (Blue-Green Algae)

Microcystis
Oscillatoria

CHLOROPHYTA (Green Algae)

Ulothrix

CHRYSTOPHYTA (Yellow-Brown Algae)

Bacillariophyceae

Synura
Asterionella
Cyclotella
Cymbella
Diatoma
Fragilaria
Melosira
Navicula
Pinnularia
Rhizosolenia
Stephanodiscus
Surirella
Synedra
Tabellaria

ROTIFERA

Asplanchna
Kellicottia
Keratella

ARTHROPODA

Crustacea

Copepoda

Diaptomus

Insecta

Diptera

Chironomidae

Chironomus
Procladius

Appendix 2. Plankton and benthos collected from Horseshoe Lake.

CYANOPHYTA (Blue-Green Algae)

Anabaena
Gloeocystis
Lyngbya

CHLOROPHYTA (Green Algae)

Ankistrodesmus
Eudorina
Pediastrum
Planctonema
Scenedesmus
Sphaerocystis
Ulothrix

Desmidiaceae

Closterium
Cosmarium

CHRYSTOPHYTA (Yellow-Brown Algae)

Dinobryon bavaricum
D. cylindricum
D. divergens
D. sertularia
Mallomonas
Synura uvella

Bacillariophyceae

Achnanthes
Asterionella
Cocconeis
Coscinodiscus
Cyclotella
Cymbella
Diatoma
Diploneis
Entomonus ornata
Eunotia
Fragilaria
Gomphonema
Melosira
Navicula
Nitzschia
Pinnularia

Rhizosolenia
Stauroneis
Stephanodiscus
Surirella
Synedra
Tabellaria

PYRRHOPHYTA (Dinoflagellates)

Ceratium hirundinella

ROTIFERA

Asplanchna
Kellicottia
Keratella
Trichocerca

ARTHROPODA

Crustacea

Branchiopoda

Cladocera

Daphnia
Holopedium

Copepoda

Cyclops

Insecta

Diptera

Chironomidae

Chironomus
Procladius

Trichoptera

Phylocentropus placidus

MOLLUSCA

Pelecypoda

Sphaeriidae

Sphaerium simili
S. rhomboidum

Appendix 3. Plankton and benthos collected from Long Lake.

CYANOPHYTA (Blue-Green Algae)

Chroococcus
Coelosphaerium naegliana
Gloeocystis
Lyngbya
Radiocystis geminata

CHLOROPHYTA (Green Algae)

Actinastrum
Dichotomococcus
Eudorina
Pediastrum boryanum
P. simplex
Planctonema lauterbonnii
Scenedesmus
Spirocyra
Ulothrix

Desmidiaceae

Closterium setaceum
Staurostrum
Staurodesmus cuspidatus
Xanthidium

CHRYSTOPHYTA (Yellow-Brown Algae)

Dinobryon bavaricum
D. sertularia
D. socialis
Synura uvella

Bacillariophyceae

Asterionella
Cymbella
Diatoma
Fragilaria
Melosira
Rhizosolenia
Stephanodiscus
Surirella
Tabellaria

PYRRHOPHYTA (Dinoflagellates)

Ceratium hirundinella

ROTIFERA

Asplanchna
Brachionus
Gastropus
Kellicottia
Keratella
Polyarthra

ARTHROPODA

Crustacea

Branchiopoda

Cladocera

Bosmina
Ceriodaphnia
Holopedium

Copepoda

Diaptomus
Limnocalanus macrurus

Ostracoda

Insecta

Diptera

Chironomidae

Chironomus
Glyptotendipes
Harnischia complex
Stempellina

Megaloptera

Sialis

MOLLUSCA

Pelecypoda

Sphaeriidae

Pisidium sp
Sphaerium sp

Appendix 4. Catch summary of net sets 1 to 6 made in Night Owl Lake.

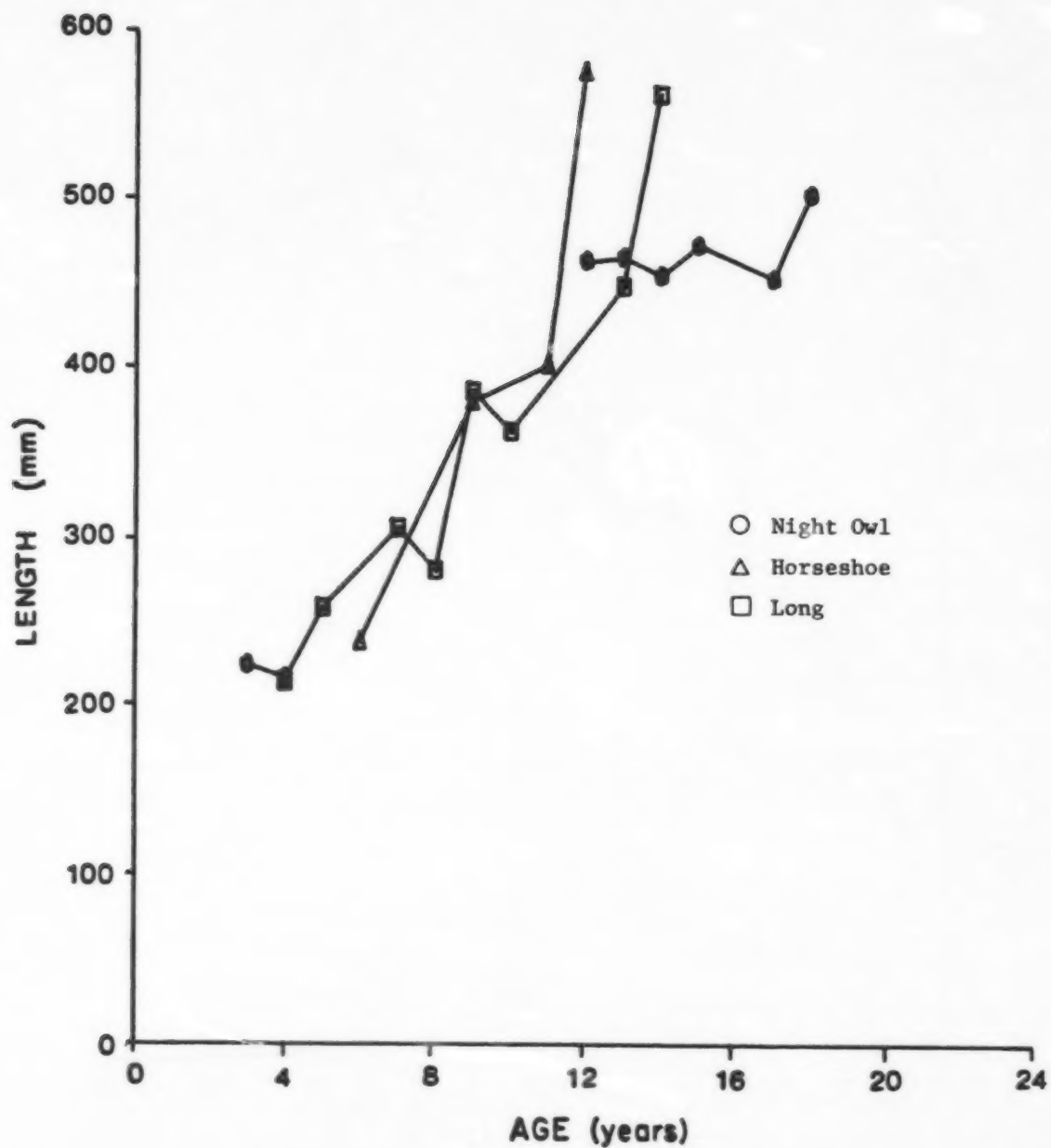
Set location	Date of set	Walleye	Northern pike	Yellow perch	Sauger	White sucker	Tullibee	Rock bass	Mooneye	Total
1	June 5	7	5	7		-	1	-	-	20
2	June 5	5	7	-		1	6	-	-	19
3	June 5	-	2	-		-	1	-	-	3
4	June 6	-	4	-		-	17	-	-	21
5	June 6	-	5	-		-	-	-	2	7
6	June 6	2	4	-	4	-	-	1	-	11
Total caught		14	27	7	4	1	25	1	2	81
Total sampled		14	27	7	4	1	25	1	2	81
Total aged		14	26	-	4	-	-	-	-	44

Appendix 5. Catch summary of net sets of 1 to 10 made in Horseshoe Lake.

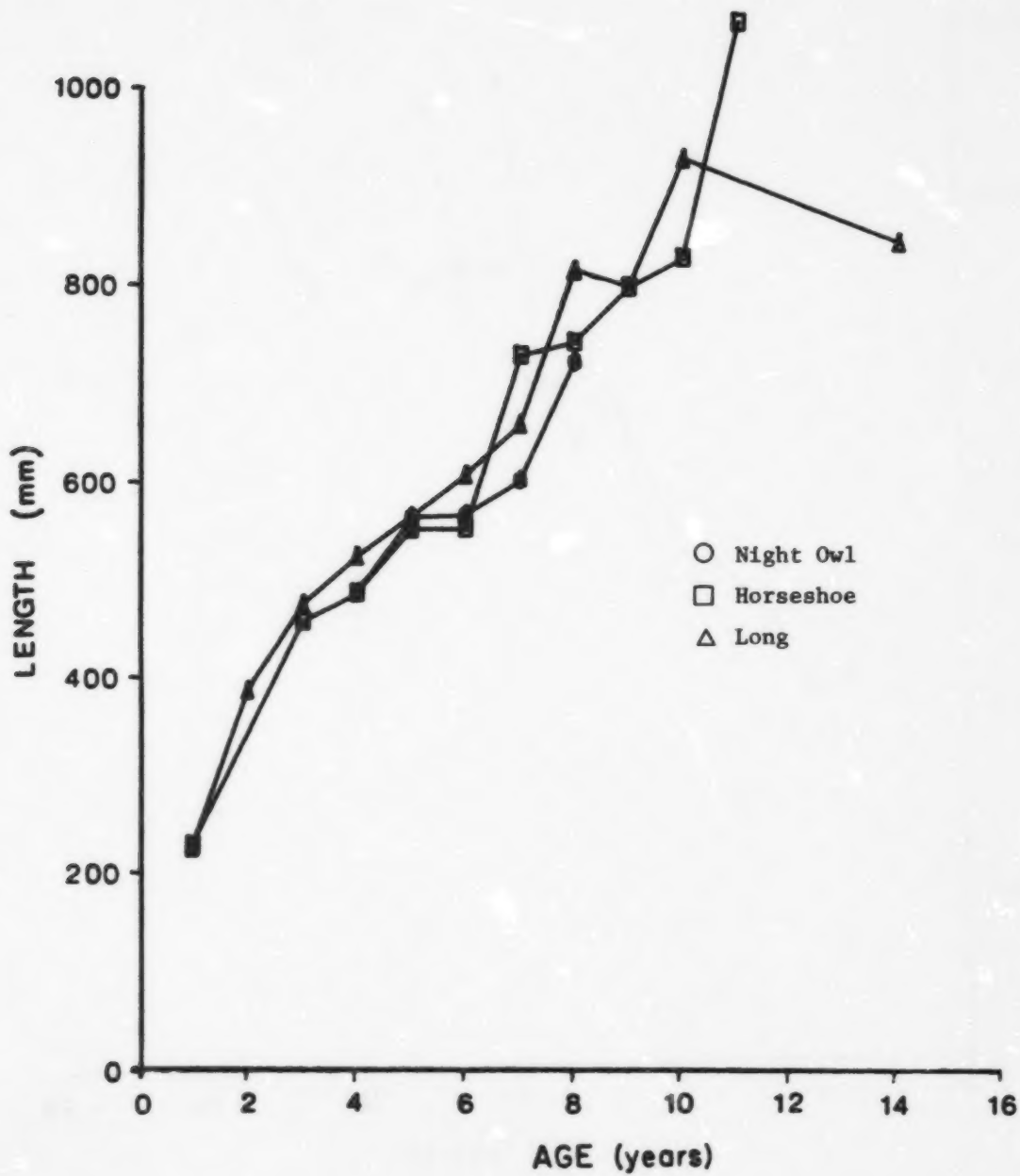
Set Location	Date of set	Walleye	Northern pike	Yellow perch	Sauger	White sucker	Shorthead redhorse	Tullibee	Mooneye	Whitefish	Rock bass	Total
1	June 10	-	-	-	-	-	-	-	-	-	-	-
2	June 10	3	7	4	1	1	1	1	2	-	-	20
3	June 10	-	3	-	-	2	-	1	2	-	-	8
4	June 11	1	12	-	-	1	-	2	1	-	-	17
5	June 11	2	1	-	-	-	-	2	9	-	-	14
6	June 11	2	14	-	1	3	1	-	3	1	-	25
7	June 11	2	-	-	2	-	-	-	-	-	1	5
8	June 12	2	5	2	1	1	2	-	2	-	-	15
9	June 12	5	7	2	2	4	2	2	19	1	-	44
10	June 12	1	3	8	2	4	1	1	-	-	-	20
Total caught		18	52	16	9	16	7	9	38	2	1	168
Total sampled		18	52	16	9	16	7	9	38	2	1	168
Total aged		18	52	-	-	-	-	-	-	-	-	70

Appendix 6. Catch summary of net sets 1 to 7 made in Long Lake.

Set location	Date of set	Walleye	Northern pike	Yellow perch	Sauger	White sucker	Shorthorn redhorse	Tullibee	Mooneye	Total
1	June 16	-	4	-	-	-	-	-	2	6
2	June 16	4	21	4	-	1	2	2	12	46
3	June 17	-	-	-	-	-	-	-	2	2
4	June 17	-	-	-	-	-	-	-	1	1
5	June 18	1	1	-	1	-	-	2	6	11
6	June 18	1	1	-	-	1	-	-	-	3
7	June 19	-	1	-	-	-	-	-	14	15
Total caught		6	28	4	1	2	2	4	37	84
Total sampled		6	28	4	1	2	2	4	37	84
Total aged		6	27	-	1	-	-	-	-	34



Appendix 7. Temporal changes in mean length of walleye from Night Owl, Horseshoe and Long lakes.



Appendix 8 Temporal changes in mean length for northern pike from Night Owl, Horseshoe and Long lakes.